Editorial

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Biographical notes: Steven L. Krahn performs research in the nuclear fuel cycle, risk assessment, systems engineering and assessing the risk of new technology insertion in complex, high-hazard systems. Immediately prior to joining Vanderbilt, he was a Deputy Assistant Secretary for Safety and Security at the US Department of Energy (DoE). For his service, he received the DoE Career Meritorious Service Award. He holds a PhD in Public Administration (University of Southern California), MS in Materials Science (University of Virginia) and BS in Metallurgical Engineering (University of Wisconsin); he has taught systems engineering at the University of Maryland and George Washington University.

Previously, this journal produced a volume focused on an application of system of systems engineering (SoSE) methods to a particular challenge: radio frequency information exchange in a US aircraft carrier strike group (Volume 2, Nos. 2/3, 2011). To continue to develop SoSE approaches or methodologies (Adams and Keating, 2011), the journal has once again brought together a spectrum of authors to address topics of importance to the practice of SoSE. These articles take on the topics related to system of systems (SoS) theory, general SoSE implementation challenges and the application of SoSE methods to information systems challenges. An introduction to the articles in each of these three areas is provided below, followed by a brief, challenging conclusion.

Adams explains a multi-disciplinary theoretical foundation and discipline-agnostic framework developed at the National Centers for System of Systems Engineering for systems theory; the construct is posited as a general approach to understanding system behaviour. Stakeholders exist at the centre of all systems problems note Hester, Bradley and Adams; the authors provide an approach for classifying stakeholders, determining an appropriate level of action to take with respect to stakeholders, and an attitude classification schema. Next, Adams and Hester discuss six classifications for problem solving errors that may be experienced independent of the systems or philosophical construct philosophical construct, or procedural rigor, used in addressing the complex systems problem. Concluding this section, Keating and Katina describe a set of common, systems-based pathologies that may be prevalent in SoS's; implications for utilising systems theory to aid in understanding the pathologies, their manifestation, systemic assessment, and strategies for system redesign are explored.

The multifaceted definition and characteristics of a SoS (Sousa-Posa et al., 2008) also ensure that it is impossible to truly optimise it; however Hester, using the concepts of satisficing and finite causality, helps us understand when we can declare that a 'good enough' solution is sufficient. Meyers and Hester then note that, due to their multifaceted definition and characteristics, systems of systems demand performance measurement schemes that set them apart from individual systems; they discuss enterprise AID as a means for measuring and managing the performance of SoS's. SoSE is a relatively new field, as with all new disciplines, education in the emerging field is an important element of its development; Adams and Bradley report on a tailored training programme that has been designed for the emerging SoSE workforce. Batting cleanup, Walker and Keating examine the nature of the issues with respect to defining SoS requirements and an emerging methodology for deriving SoS requirements; this methodology adopts a primary emphasis on the top-down analysis, tempered by bottom-up validation to produce a set of SoS requirements that are less detailed than system requirements but more granular than capability objectives.

Bell describes Department of Defense (DoD) SoS practitioners as facing significant information assurance (IA) challenges related to nature or level of interoperability of their SoS (e.g., tightly or loosely coupled), noting that an IA threat to one system has varying degrees of risk to interconnected systems and that no current DoD guidance exists with respect to 2nd and 3rd order IA vulnerability effects. Data governance is also a central element in a SoS, without it, Wilbanks and Lehman argue that SoS are prone to duplicative data storage, along with invalid and unreliable data; the authors recommend data governance focus on the management of the data verses solely focusing on the configuration and funding of physical systems. Bell returns to argue that DoD needs a new paradigm to combat potential information assurance vulnerabilities and introduces the concept of securability to help establish a standardised, measurable approach to ensuring a system meets its mission objectives in a secure manner. The US Navy has made strides in integrating technology to monitor and assess the condition of sub-systems; however, Hester, Adams and Kern observe that little is understood about how to fuse this data. The authors propose the viable system model as a hierarchical construct for managing this fusion and suggest research in calculating system reliability to manage both aleatory and epistemic uncertainty.

The refinements made to the theory underpinning SoSE, coupled with the more granular set of both general and information systems implementation issues addressed above, indicate that clear progress has been made in defining the practice of SoSE since ground-breaking articles such as Maier (1998) and Sage and Cuppan (2001) or older summaries of the state of the practice. With reflective practitioners making such thoughtful additions to the body of knowledge, perhaps SoSE is no longer an emerging, but rather a maturing discipline.

References

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